Title: Composting "The Right Mix" Written by GEF Staff
Grades: Middle School
Subjects: Math, Science
Time: 30 minutes

Standards: Students will...
Science Standard 2: Understand Earth's composition and structure.

- Benchmark # 3: Know components of soil and other factors that influence soil texture, fertility, and resistance to erosion.

Science Standard 5: Understand the structure and function of cells and organisms.

- Benchmark # 9: Know that cells use inorganic compounds (e.g., minerals, water) to make materials that the cells or organism needs.

Science Standard 6: Understand relationships among organisms and their physical environment.

- Benchmark # 5: Know how matter is recycled within ecosystems (e.g., matter is transferred from one organism to another repeatedly, and between organisms and their physical environment; the total amount of matter remains the same, even though its form and location change).

Mathematics Standard 2: Understand and apply basic and advanced properties of the concepts of numbers.

- Benchmark # 1: Understand the relationship between equivalent number representations (e.g., ratios) and the advantages and disadvantages of this type of representation.
- Benchmark # 9: Understand the concepts of ratio, proportion and percent and the relationships among them.

Mathematics Standard 3: Uses basic and advanced procedures while performing the processes of computation.

- Benchmark # 6: Use proportional reasoning to solve mathematical and real-world problems (e.g., involving ratios and proportions).

Objectives: Students will be able to...

- Identify soil as consisting of weathered rock and decomposed organic material.
- Explain the benefits of composting to improve soil quality and describe the balance required between brown/carbon-producing materials and green/nitrogen-producing materials.
- Use the concept of ratio to represent quantitative relationships.

Materials:

- Six lemons
- Six cups of cold water
- 1 cup of white sugar
- Measuring cup
- Lemonade pitcher
- Spoon
- Small paper cups
- Worksheet provided

Overview: Compost is the remains of organic matter that have been allowed to decompose into a natural fertilizer. A compost heap requires two types of ingredients: carbon-producing materials (brown materials) and nitrogen-producing materials (green materials). The right balance of carbon and nitrogen materials is essential in controlling the decomposition process. If the amount of decaying matter is not properly balanced the result is less than optimal. For example, decomposing remains of fruit must be mixed with the right amount of green ingredients or the heap will develop an odor.

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Every natural material has a ratio of carbon to nitrogen production. The ideal carbon-nitrogen ratio for a compost heap is 25-30 parts of carbon to 1 part of nitrogen. Written as a ratio it looks like 25-30:1. Many ingredients don't have the right ratio of carbon to nitrogen. Materials with high C:N ratios may be lowered by adding additional ingredients, such as grass clippings or manures. Materials with low C:N ratios may be raised by adding materials, such as paper, dry leaves or wood chips. In this lesson the students will find the right mix to create compost, an important additive to any garden.

Kid's Speak: When you build a compost heap, you need two types of ingredients and you must add the right amount of each ingredient, just like in a recipe. But you can't measure out ingredients like you can sugar or flour. You have to know the correct units to use. A compost's "recipe" calls for materials that have 25-30 parts of brown material for every one part of green material. This is called a ratio and is written as 25-30:1. The brown materials in the "recipe" produce carbon and the green materials produce nitrogen. Both are needed to make compost. Sometimes when combining ingredients they are measured out incorrectly. If there is too much brown material, green ingredients can be added, and if there are too many green ingredients, more brown material can be added. When you have the right mix, you have a recipe for success!

Eco-Fact: Home composting can eliminate about 700 lbs. of material per household per year from the waste stream.

Procedures:

- Before Creating "The Right Mix":
- Begin the class by asking students if anyone would like a nice, cool glass of lemonade. Display the ingredients for lemonade: half a dozen lemons, a pitcher of cold water and white sugar. Explain to students that these are the ingredients for making lemonade, but that a recipe is needed to know the right proportions to use. To make a pitcher of old fashion lemonade the "right mix" is 1 part lemon juice, to 6 parts water, to 1 part sugar or 1:6:1. Each part has to be measured using the same unit of measure. In the case of lemonade a cup is used as the unit of measure. Given the information provided, ask students to write the recipe for old fashion lemonade.

Recipe for Old Fashion Lemonade:

- 1 cup lemon juice
- 6 cups cold water
- 1 cup white sugar

- Squeeze lemons to yield I cup juice. Add juice and sugar to water. Stir until dissolved.
- Ask students what would happen if the amount of sugar were changed to 3 cups? (The lemonade would be too sweet.) Ask students what would happen if the ratio of sugar were changed to 3 cups? (The lemonade would be too sweet.) Why? (The mixture would be out of balance). Serve students a small cup of lemonade so they can taste the right mix of ingredients.
- Explain what compost is and the benefits it provides in the garden. Explain to students, that similar to using a recipe, the "right mix" of ingredients is important when making compost. Explain to the class that to make compost two types of ingredients are needed: brown/carbon-producing materials and green/nitrogen-producing materials, and that there needs to be a proper balance between these materials.

Creating the "Right Mix":

- Discuss ratio in terms of compost ingredients. Distribute the worksheet. The top half of the worksheet lists the ratios needed to make compost. Use the information to complete the worksheet in a whole group activity, explaining to students how to create correctly balanced pairs of ingredients for making compost.

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Brown Carbon Producing Materials	Green Nitrogen Producing Materials
Ashes, wood 25:1	Food Scraps 15:1
Dried leaves 60:1	Grass clippings 18:1
Pine needles 90:1	Coffee Grounds 20:1
Newspaper 125:1	Horse Manure 25:1
Sawdust 625:1	Alfalfa 12:1

Math Using Ratios:
1. If our class wants to use newspaper in the compost heap, we need to put in _____ times as much horse manure. Answer: 5

2. The class has two compost ingredients: Food scraps (green) and dried leaves (brown). For the ingredients to be in balance with each other, the class needs to use _____ times as much food scraps. Answer: 4

3. _____ (brown) and _____ (green) are the only two ingredients that don't need an extra amount for the heap to be in balance. Answer: wood, ashes/brown and horse manure/green, each have a ratio of 25:1

4. True or False: If the class only has a small amount of alfalfa, the students should use newspaper to put the heap in balance. Explain your response. Answer: False

5. True or false: The class has collected pine needles for their compost heap. Next, they want to add grass clippings. One student says they need to use 5 times as much grass clippings as pine needles for it to be in balance. Explain your response. Answer: True

After Creating "The Right Mix":
- Students will use what they have learned about ratios and balanced pairs, the optimum carbon to nitrogen ratio for making compost, and the lists of ratios for brown and green ingredients to create their own compost recipes. They will write explanation as to how their recipe provides for the "right mix" of carbon to nitrogen for making compost.

Adaptations:
- In cooler seasons or climates replace lemonade with hot chocolate for the introductory activity.
- Younger students can differentiate between brown and green materials and cut out pictures of the different composting materials from magazines and newspapers.

Extensions:
- Make an indoor or outdoor compost heap. Collect brown and green ingredients. Be sure to determine the correct ratio of carbon to nitrogen output. Select more materials based on how you need to balance the mixture. Mix the compost heap materials. Refer to GEF lessons for Grades 3-5 for suggestions.
- Keep an observation notebook for an already existing heap. Note its materials, scent and rate of decomposition. If it develops an odor, or the process decreases, discuss ways you need to correct the problems, based on the brown-green ratio.
- For tips on dietary guidelines and healthy eating habits visit the USDA Food Pyramid.

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